CLAIMS

What is claimed is:

1. A cardiac monitoring device, comprising:

a housing;

amplification circuitry provided in the housing, the amplification circuitry configured to have a first amplifier input and a second amplifier input, the first amplifier input having a first input impedance and the second amplifier input having a second input impedance different from the first input impedance;

a first electrode arrangement coupled to the first amplifier input;

a second electrode arrangement coupled to the second amplifier input; and

a signal processor provided in the housing and coupled to the amplification circuitry, the signal processor configured to separate a source signal using a first composite signal detected at the first input impedance and a second composite signal detected at the second input impedance.

2. The device of claim 1, wherein the second input impedance is adjustable relative to the first input impedance.

3. The device of claim 1, wherein the first input comprises a first input amplifier circuit and the second input comprises a second input amplifier circuit, further wherein a phase response of the first input amplifier circuit is about equal to that of the second input amplifier circuit.

4. The device of claim 1, wherein the first electrode arrangement and the second electrode arrangement are operable at a separation distance of about 2 centimeters or less.

5. The device of claim 1, comprising a lead coupled to the housing, wherein the first electrode arrangement and the second electrode arrangement are located on the lead.

6. The device of claim 5, wherein the first electrode arrangement comprises at least one bipolar electrode arrangement.

7. The device of claim 1, the housing comprising an electrode arrangement in or on the housing.

8. The device of claim 1, wherein the first electrode arrangement comprises at least one electrode arrangement configured for subcutaneous placement in a patient.

9. The device of claim 1, wherein the first electrode arrangement comprises at least one electrode array configured for subcutaneous placement in a patient.

10. The device of claim 1, wherein the first electrode arrangement comprises at least one surface electrode arrangement.

11. The device of claim 1, wherein the first electrode arrangement comprises at least one intracardiac electrode arrangement.

12. The device of claim 1, wherein each of the first and second amplifiers comprises a sample and hold amplifier.

13. The device of claim 12, wherein the device comprises a multiplexer coupled to outputs of the first and second amplifiers and to the signal processor.

14. The device of claim 12, wherein the respective sample and hold amplifiers sample the first and second composite signals substantially synchronously.

15. The device of claim 12, wherein the electrode arrangement comprises intracardiac electrodes, and the respective sample and hold amplifiers sample the first and second composite signals substantially synchronously at a sampling frequency greater than about 400 Hz.

16. The device of claim 12, wherein the electrode arrangement comprises subcutaneous, non-intracardiac electrodes, and the respective sample and hold amplifiers sample the first and second composite signals substantially synchronously at a sampling frequency greater than about 50 Hz.

17. A cardiac monitoring device, comprising:

a housing;

amplification circuitry provided in the housing, the amplification circuitry configured to have a first input impedance and a second input impedance;

a switch configured to switch the amplification circuitry between the first input impedance and the second input impedance;

an electrode arrangement coupled to the amplification circuitry; and

a signal processor provided in the housing and coupled to the amplification circuitry, the signal processor configured to separate a cardiac signal using a first composite signal sensed at the first input impedance and a second composite signal sensed at the second input impedance.

18. The device of claim 17, wherein the second input impedance is adjustable relative to the first input impedance.

19. The device of claim 17, wherein the amplification circuitry comprises a first channel associated with the first input impedance and a second channel associated with the second input impedance.

20. The device of claim 17, wherein the electrode arrangement comprises intracardiac electrodes, and the switch switches between the first and second input impedances at a frequency greater than about 800 Hertz.

21. The device of claim 17, wherein the electrode arrangement comprises subcutaneous, non-intracardiac electrodes, and the switch switches between the first and second input impedances at a frequency greater than about 100 Hertz.

22. The device of claim 17, wherein the switch switches between the first and second input impedances during a cardiac cycle.

23. The device of claim 17, wherein the switch switches from one of the first and second input impedances to the other of the first and second input impedances after a duration exceeding one or more cardiac cycles.

24. The device of claim 17, wherein the first electrode arrangement and the second electrode arrangement are bipolar electrode arrangements separated by less than about 2 centimeters.

25. The device of claim 17, wherein the electrode arrangement is configured for intrathoracic placement in a patient.

26. The device of claim 17, wherein the electrode arrangement is configured for subcutaneous placement in a patient.

27. The device of claim 17, the housing comprising a housing electrode arrangement in or on the housing, the housing electrode arrangement comprising one or both of a can electrode and an indifferent electrode arrangement.

28. The device of claim 17, the signal processor comprising a filter configured to filter the composite signal to remove frequencies associated with switching.

29. The device of claim 17, the signal processor samples the first and second composite signals substantially synchronously at a time when the first and second composite signals are valid to remove frequencies associated switching.

30. The device of claim 17, wherein the electrode arrangement comprises an electrode array configured for subcutaneous placement in a patient.

31. The device of claim 17, wherein the electrode arrangement comprises at least one surface electrode arrangement.

32. A method of signal separation, comprising:

receiving, at a first input impedance, a first composite signal from an electrode arrangement;

receiving, at a second input impedance, a second composite signal from the electrode arrangement;

selecting a target source impedance; and

separating a cardiac signal from the first and second composite signals using the selected target source impedance.

33. The method of claim 32, wherein the first input impedance is selected to be greater than about 100K Ohms.

34. The method of claim 32, wherein the second input impedance is selected to attenuate a target source signal to between about one-fourth to about three-fourths of the target source signal from the first composite signal.

35. The method of claim 32, wherein the second input impedance is selected to attenuate a target source signal to a predefined fractional level of the target source signal from the first composite signal.

36. The method of claim 32, wherein separating the cardiac signal comprises separating the cardiac signal using an attenuation factor defined by a ratio of amplitudes of the first and second composite signals.

37. The method of claim 36, wherein the attenuation factor is determined from sensed normal sinus rhythm beats.

38. The method of claim 37, wherein the attenuation factor is updated periodically.

39. The method of claim 36, further comprising:

computing a subsequent attenuation factor;

comparing the attenuation factor to the subsequent attenuation factor; and

verifying that the separated cardiac signal represents a cardiac electrophysiological signal based on the comparison.

40. The method of claim 39, further comprising discriminating between noise and the ventricular tachyarrhythmia based on the comparison.

41. The method of claim 32, wherein the cardiac signal is separated using a linear combination of the first composite signal and the second composite signal.

42. The method of claim 32, wherein the second composite signal is received by an amplifier having a plurality of selectable discrete input impedances, and a selected amplifier input impedance attenuates a target source signal from the second composite signal to between about one-fourth to about three-fourths of the target source signal from the first composite signal.

43. The method of claim 32, wherein the electrode arrangement comprises a first electrode assembly and a second electrode assembly, the first electrode assembly sensing the first composite signal at the first impedance, and the second electrode assembly sensing the second composite signal at the second impedance.

44. The method of claim 43, wherein the first and second composite signals are sampled synchronously.

45. The method of claim 32, wherein the electrode arrangement comprises an electrode arrangement and a switch, the switch actuatable to select between the first input impedance and the second input impedance.

46. The method of claim 45, comprising band-pass filtering the first and second composite signals to remove frequencies related to switching between the first input impedance and the second input impedance.

47. The method of claim 45, comprising sampling the first and second composite signals substantially synchronously at a time when the first and second composite signals are valid to remove frequencies associated switching.

48. The method of claim 32, further comprising performing cardiac rhythm detection using the separated cardiac signal.

49. The method of claim 32, comprising providing a cardiac monitoring and stimulation device configured to implement the signal separation method.

50. The method of claim 32, comprising band-pass filtering the first and second composite signals.

51. A cardiac monitoring device, comprising:

a housing;

amplification circuitry provided in the housing, the amplification circuitry configured to have a first impedance circuit and a second impedance circuit, the first impedance circuit having a first impedance and the second impedance circuit having a second impedance different from the first impedance; and

means for separating a source signal using a first composite signal detected at the first impedance and a second composite signal detected at the second impedance.

52. The device of claim 51, comprising means for switching between the first and second impedance circuits.

53. The device of claim 52, comprising means for filtering the first composite signal and the second composite signal, the filtering means configured to remove frequencies associated with the switching means from the first composite signal and the second composite signal.

54. The device of claim 52, comprising means for sampling the first and second composite signals substantially synchronously at a time when the first and second composite signals are valid to remove frequencies associated switching.

55. The device of claim 51, comprising means for filtering the first composite signal and the second composite signal.

56. The device of claim 51, comprising means for synchronously sampling the first and second composite signals.

57. The device of claim 51, comprising means for changing the impedance of one or both of the first impedance circuit and the second impedance circuit.

58. The device of claim 51, wherein the separating means uses a target source impedance to separate the source signal.